6

The Development of Curiosity Within the Genus *Panthera*

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(Text-figures 1 & 2)

RESPONSE to novel objects, frequently taking the form of play, is one of the most striking behavioral characteristics of the infant mammal. Moreover, it is generally accepted that such reactivity reaches a peak during the early life of the animal and then declines during adult life. As Beach (1945) has indicated, however, there has been little systematic data on which to base this belief, primary support for the view being provided by a wealth of anecdotal lore (Welker, 1961). In one of the first experimental approaches to this question, Welker (1956) examined the development of curiosity in the chimpanzee and substantiated the existance of a period of maximum reactivity followed by a reduction in magnitude of response.

The present report concerns an analysis of the ontogeny of curiosity in a group of zoo-reared cats. Our procedure has been adapted from the one previously employed by Welker (1956).

METHOD

Subjects.—Twenty-two infant cats were tested including: 3♂ and 2♀ lions *(Panthera leo),* 4♂ and 2♀ tigers *(Panthera tigris),* 3♂ and 2♀ leopards *(Panthera pardus),* 3♂ and 2♀ jaguars *(Panthera onca),* and 1♀ snow leopard *(Panthera uncia).* Two of these animals, a lion and a tiger, had to be dropped from the final sample when they became excessively disturbed during the tests. All of these animals were born at the Lincoln Park Zoo in Chicago between 1960 and 1962. It is standard procedure at the zoo to remove baby cats from their mothers at birth and rear them in incubators. Surviving members of a multiple birth are reared together, barring the development of some infection. Therefore, these animals generally had considerable contact with a member of their own species, as well as with their keepers.

An additional sample of adult cats, including 2 tigers, 2 leopards, and 2 jaguars, was tested at the New York Zoological Park during the summer of 1961. One male and one female of each species was tested. All had been born and reared in the zoo. The 2 tigers were approximately 4 years old and the 2 jaguars approximately 12 years old, while the male and female leopards were 16 and 3 years old, respectively.

Apparatus.—The following objects were used to evoke responses from the infant cats: (1) Two wooden "blocks," including a 12-in. length of 1 × 2 and a 6-in. length of 1 × 1; (2) Two pieces of steel chain, including a 12-in. length of #210 tensile chain and a 6-in. length of single jack chain; (3) Two wooden dowels, including a 12-in. length of ⅝-in. dowel and a 6-in. length of ⅜-in. dowel; (4) Two pieces of black rubber tubing, including a 12-in. length of ½-in. tubing and a 6-in. length of ¼-in. tubing; (5) A crumpled piece of white bond paper, 8½ × 11 in.

The objects used with our adult sample were similar to the above, but were scaled to a larger size, except for the crumpled paper which was of the same dimensions as that used with the infant animals. (1) The wooden blocks consisted of a 24-in. length of 2 × 4, and a 12-in. length of 1 × 2; (2) The pieces of chain included a 24-in. length of #20 welded chain and a 12-in. length of #210 tensile chain; (3) The dowels included a 36-in. length ⅞-in. dowel and a 12-in. length of ⅝-in. dowel; (4) The two pieces of rubber tubing were 24 in. × 1 in. and 12 in. × ½ in.

With few exceptions, each stimulus object was used with but a single cat, in order to avoid re-

sidual influences of prior tests. The exceptions all occurred with the large chain used with the adult cats. As we were unable to obtain sufficient new chain of this type, we were forced to reuse some lengths. However, all such pieces of chain were carefully washed before reusing.

These objects were similar to those used in a previous study (Glickman, Sroges & Hoff, 1961) and were chosen to provide a wide range of textures, odors and shapes.

Procedure.—All animals were tested either in their home cages or in an identical cage to which they had been habituated prior to testing. Testing was carried out between 5 and 10 p.m. when the zoo was closed to the public.

Each stimulus set listed above was placed in a subject's cage for a single 6-min. test session. At the end of the 6th minute, the stimulus set was withdrawn and, after a lapse of 10 minutes, the next stimulus set was placed in the cage. Objects were always presented to the cats in the following order; wooden blocks, chains, dowels, rubber tubing and crumpled paper.

Responses were scored by the experimenter on a sheet ruled into 72 squares. Each minute was divided into twelve 5-sec. periods. If an animal either oriented toward an object or touched it, a notation was made in the appropriate square. Contacts with objects which occurred without orientation, *i.e.*, those apparently made accidentally during the animal's movement about the cage, were not scored. If an animal both contacted an object and examined it visually simultaneously, only a contact response was scored. Thus, the maximum score, if an animal responded to an object throughout a 6-min. session, was 72. In the later tests, a record was kept of the animal's mode of contact with the objects and the vigor of its responses.

Efforts were made to retest all of our infant cats. Unfortunately, it was not possible to schedule retests at regular intervals and in some cases second tests were never obtained. However, we ultimately were able to test three subjects on three occasions, and ten subjects on two occasions. The remaining seven cats were given but a single test.

All adults cats were retested after a 4-wk. interval.

Results

Quantity of Response in Infant Cats.—In order to provide an over-all view of the relationship between age and quantity of response, mean response scores were computed for each animal. These mean values were derived by summing the total response scores to the different test stimuli and dividing the result by five. Each of these mean scores was then entered as a single box in the appropriate column of Text-fig. 1.[1] A total of 10 tests between 4-6 weeks, 17 tests between 8-13 weeks and 6 tests between 15-24 weeks are represented in this bar graph. Inspection of this graph reveals a systematic increase in response from the first to the third age group, with all age groups differing significantly from one another ($p < .05$).[2] There is no overlap in scores between the first and third groups.

Analysis of data from repeated tests supports the above result in nearly every case. Eight subjects were tested during both the first and second age periods. Six of these animals increased markedly in mean response during this time, while two animals showed slight declines, giving a mean increase of 18.1. Six animals were tested both during the 8-13 week period and the 15-24 week period. All of these animals showed increased mean scores, with an average increment for the group of 29.0. The single snow leopard was first tested at 9 wks. of age, obtaining a mean response score of 68.4. Retests were carried out at 14 and 52 weeks, at which times the mean response scores were 53.6 and 71.5. This snow leopard was highly reactive from the earliest tests and displayed a full range of chewing, swatting and leaping responses to the objects.

The trend toward increased response with increasing age, among the infant animals, occurs with all five test stimuli (Table 1).

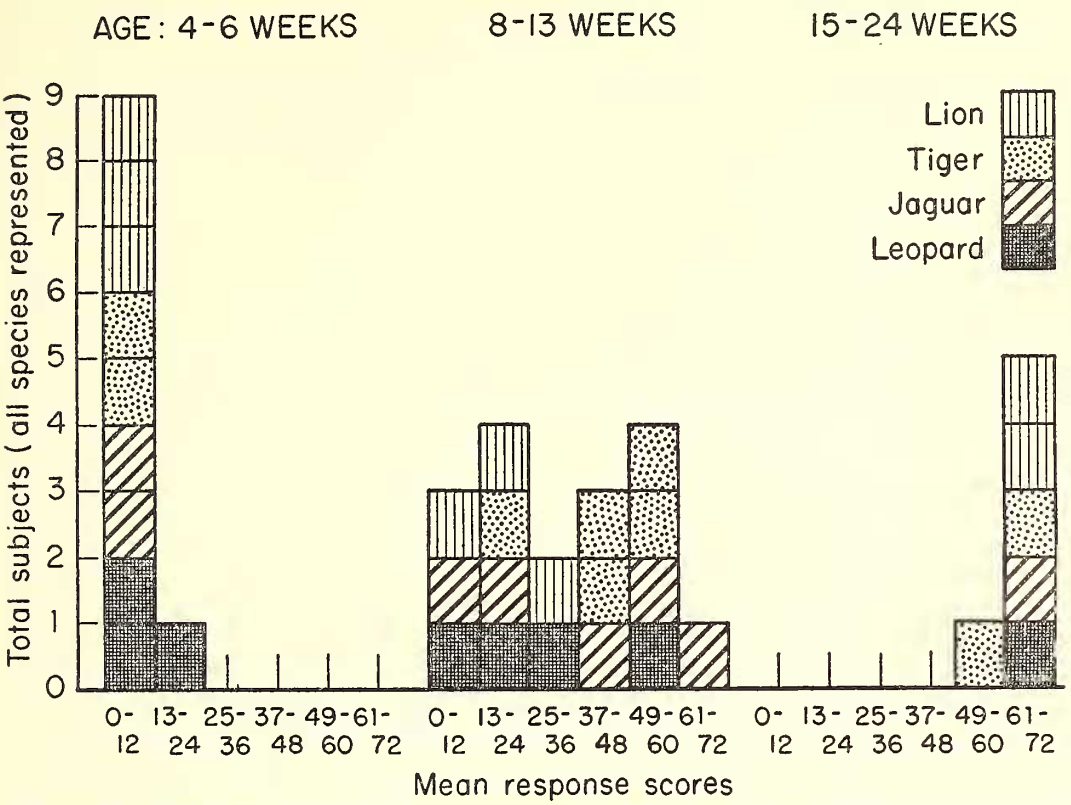
The sample size is too small to permit assessment of possible species differences in rate of development; however, reference to Text-fig. 1 indicates a fairly even distribution of scores within our age categories for all four species. In the only case where statistical comparison is feasible, the five 8-13-week-old tigers (mean response score = 42.2) do not differ significantly ($p > .10$) from the five jaguars in the same age group (mean response score = 36.6).

Habituation in Infant Cats.—There is no evidence for a significant decline in response with continued exposure of the infant cats to the test stimuli during the 6-min. test sessions (Text-fig. 2). The apparent trend toward habituation in the 4-6-week group is due entirely to the behavior of two leopards who were quite responsive at the beginning of each test session, but fell asleep toward the close of the session.

Categories of Response in Infant Cats.—Our literary protocols, detailing the modes of reaction used by infant cats, contain only general,

[1]The results obtained with the infant snow leopard are omitted from this and all subsequent tabulations, as only one representative of this species was available.

[2]Wherever a significance level is reported in this paper, the Mann-Whitney U-test (Mosteller & Bush, 1954) constituted the statistical procedure employed.



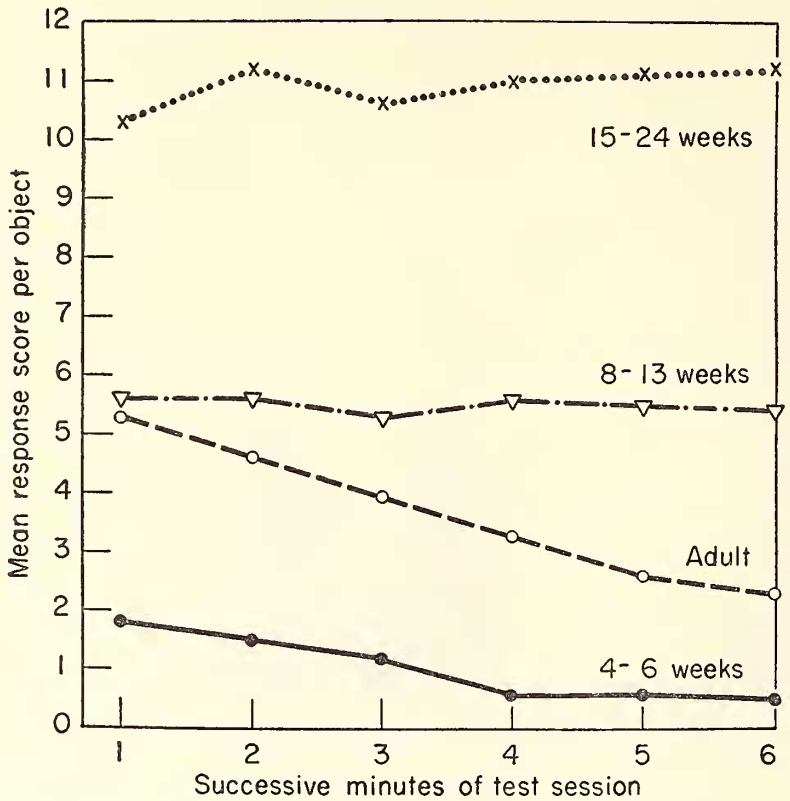
TEXT-FIG. 1. Mean response scores for individual animals according to age and species. Each box represents the mean response score of a single subject of the appropriate age group and the species indicated in the legend.

qualitative statements about the observed behavior. However, we have compiled the reactions of our cats according to six response categories for each age group. An animal simply had to show a particular reaction for a single 5-sec. period in order for that reaction to be appropriately tabulated; however, in most cases the tabulated reactions occurred much more frequently than that. Although our data are too scanty to permit statistical analysis, the following age trends are worth noting (Table 2): (1) A decreased number of cases where the subject falls asleep during the tests, and (2) increments in chewing, use of forepaws and vigorous play. The basic orienting response to the introduction of an object-set consisted of turning the eyes toward the object, approaching it and sniffing. This is evidently a relatively primitive reaction. It appears in animals within all of our age groups; however, only in some cases is it followed by sustained manipulation with mouth and paws.

Quantity of Response in Adult Cats.—The reactivity of our adult group is presented in Table 1 for each set of tests. It will be observed that the mean increment upon repeated testing, after a four-week interval, was 6.8. This increment was not significant ($p > .05$) and is much smaller than the increments observed with the infant groups, suggesting that increased response with increasing age, among our infant groups, was not due to any simple effect of repeated tests.

TABLE 1. MEAN RESPONSES TO DIFFERENT STIMULI ACCORDING TO AGE GROUP

Group	Blocks	Chain	Dowel	Tubing	Paper	Mean Total
4-5 weeks	9.3	3.2	5.1	2.6	8.7	5.8
8-13 weeks	38.8	31.9	22.1	30.7	35.0	31.7
15-24 weeks	58.8	65.3	69.0	69.8	67.2	66.0
Adult (test 1)	45.3	5.3	20.0	41.5	1.8	22.8
Adult (test 2)	39.0	6.2	36.2	65.0	1.2	29.5



TEXT-FIG. 2. Mean reactivity to novel objects as a function of continued exposure during test sessions.

Whether one considers the first or second set of tests, our adult sample differs significantly, in terms of mean total response, ($p < .05$) from the 15-24-week group.

Habituation in Adult Cats.—All six adult cats were less responsive in the sixth minute of the test sessions than the first (Text-fig. 2). Thus, our adult animals differ from our infant group in this respect.

Categories of Response in Adult Cats.—Our records of individual reactions are somewhat more detailed for the adult sample than for the infant groups. We have tabulated these separately for each adult cat (Table 3). The material presented in Table 3 represents a combined analysis of both the initial test and the retest. All activities checked occurred on at least two separate occasions.

Sniffing responses occurred in all of our adult cats, usually during preliminary investigation of an object. Further manipulation with the mouth and forepaws would usually, but not invariably, follow such an olfactory reaction. Simply steadying the object with the forepaws while chewing was the most common use of the limbs, but swatting the objects was also quite common. Frequently, after initial examination, the object was carried to a corner of the cage, or to a rear shelf, where vigorous manipulation ensued. Four of the six animals rolled over on their backs while manipulating the objects with forepaws or mouth. This behavior sometimes included using the hindlegs to kick at the object, or holding the object in the teeth and pushing against it with the forepaws.

Some of our subjects interrupted examination of the objects to pace the front of the cage, or to engage in characteristic stereotyped behavior, *e.g.*, rubbing the head against the bars of the cage (the ♀ tiger), or swatting the door of the cage (the ♂ tiger). Although none of our adult cats were observed to actually fall asleep during these tests, all of these subjects at some time during testing sat or reclined in the rear of the cage, or on the shelves which lined the rear wall.

Discussion

These results substantiate the common views concerning the development of high reactivity toward novel stimuli during the early months of life, with a subsequent decline in total response during the adult years. Such ontogenetic changes in reactivity parallel the development of play as

Table 2. Percentage of Subjects Exhibiting Various Behavior Characteristics to at Least One Set of Objects

Behavior	4-6-week group	8-13-week group	15-24-week group
Falling Asleep	50	23	0
Sniffing	70	69	not available
Chewing	20	85	100
Use of Forepaws	50	92	100
Vigorous Play	0	69	100
Fear	20	16	0
(Total Subjects)	(10)	(13)	(6)

observed by Cooper (1942) in the captive African lion. Cooper suggested that play increased in lions from the age of one month to approximately one year, but noted that such behavior decreased in frequency from that point and was "conspicuously infrequent" in five-year-old lions. Our results further suggest that this decline is the result of both a decrement in initial reactivity and a faster rate of habituation in adult animals. However, it should be noted that when our adult animals did react, there was frequently great richness in the reaction patterns, with perhaps even more variety of response than in the quantitatively more reactive younger animals.

The reaction patterns observed in these cats, including the use of mouth and forepaws, were strikingly similar to those analyzed by Leyhausen (1956). As Leyhausen has indicated, all of these reactions can be related to the normal prey-catching and feeding repertoires of these species. It is interesting to observe that these basic reaction patterns appeared in a group of cats that were entirely zoo-reared and, in the case of the infant animals, deprived of any maternal example. These findings also coincide with Cooper's (1942) observation that the play responses of hand-reared lion cubs were quite similar to those of maternally-reared cubs.

Table 3. Number of Adult Subjects Exhibiting Various Behavior Characteristics to at Least One Set of Objects

Behavior	Initial Test Sessions	Retest Sessions
Sniffing	6	6
Chewing	6	6
Carrying in Mouth	5	4
Shaking in Mouth	1	0
Licking Object	2	3
Holding in Paws	6	5
Swatting with Paws	5	4
Leaping at Object	0	2
Rolling on Back	3	3
(Total N)	(6)	(6)

Summary

Responses to novel stimulus objects were studied in a variety of infant and adult cats of the genus *Panthera*. Our results indicate a gradual development of reactivity in these species, with a subsequent decline in over-all level of response. However, in those cases where adult animals did react, a considerable variety of response patterns of great vigor were observed.

Acknowledgments

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References

Beach, F. A.

1945. Current concepts of play in animals. Amer. Naturalist, 79: 523-541.

Cooper, J. B.

1942. An exploratory study on African lions. Comp. Psychol. Monogr., 17: 1-45.

Glickman, S. E., R. W. Sroges & W. Hoff

1961. The evolution of response to novel objects. Amer. Psychologist, 16: 445.

LEYHAUSEN, P.

1956. Verhaltensstudien an Katzen. A. f. Tierpsychol., Monogr. Suppl. No. 2. Pp. 1-120.

MOSTELLER, F., & R. R. BUSH

1954. Selected quantitative techniques. Chapter 8 *in* G. Lindzey (Ed.), Handbook of Social Psychology. Cambridge, Mass.: Addison-Wesley.

WELKER, W. I.

1956. Effects of age and experience on play and exploration of young chimpanzees. J. Comp. Physiol. Psychol., 49: 223-226.

1961. An analysis of exploratory and play behavior in animals. *In* D. W. Fiske & S. R. Maddi (Eds.), Functions of Varied Experience. Homewood, Ill.: Dorsey Press.